BIOMAG2018 Philadelphia

OPEN SCIENCE | MEG

Guiomar Niso

August 2018

POLITÉCNICA

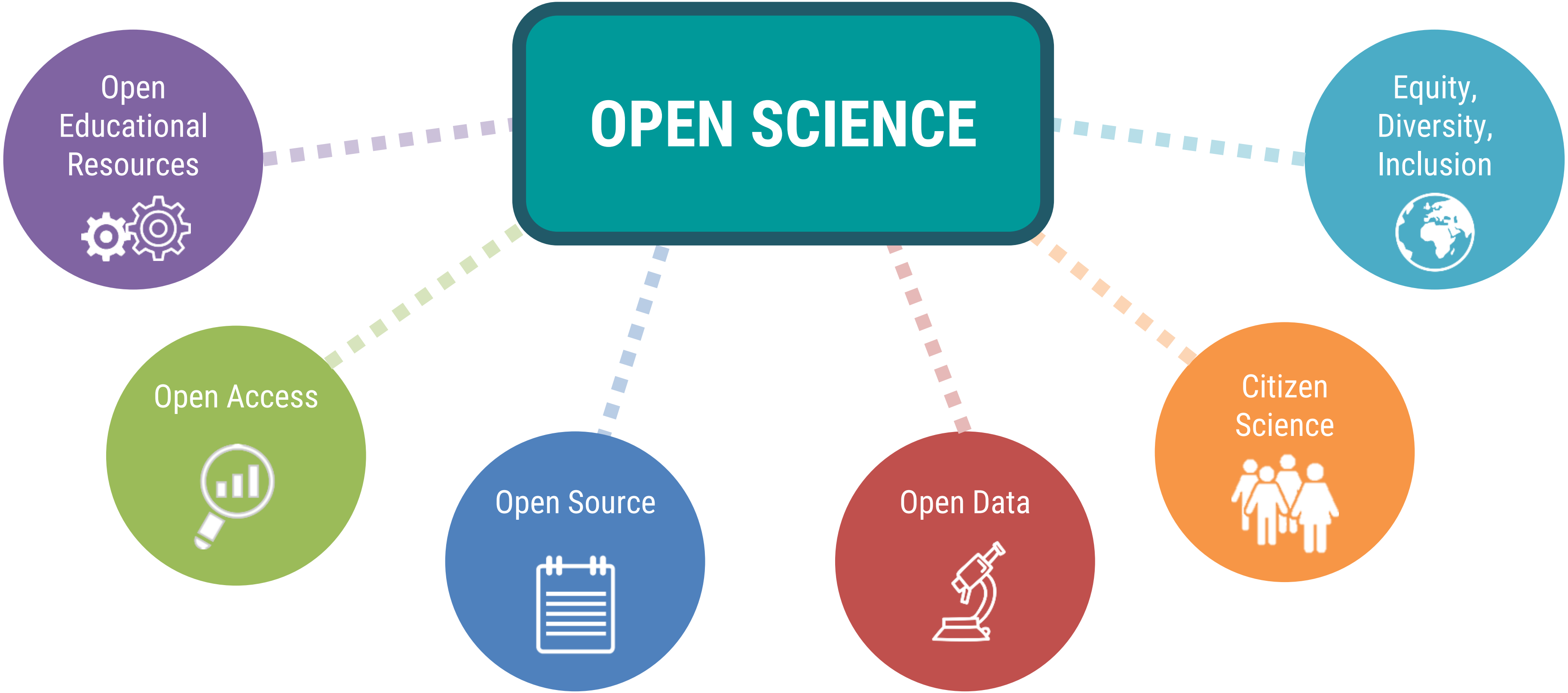
AXA Research Fund

CTB centro de tecnología biomédica

neuro

McGill

Open Science



OPEN SCIENCE

Open Educational Resources

Equity, Diversity, Inclusion

Open Access

Open Source

Open Data

Citizen Science

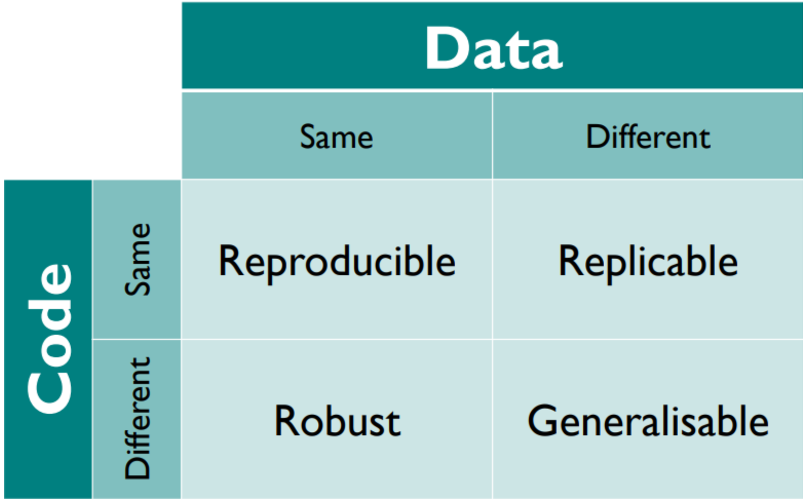
Open Science

Open Science increases

- **Long term value**
- Productivity
- Reproductibility
- Impact

The FAIR data principles:

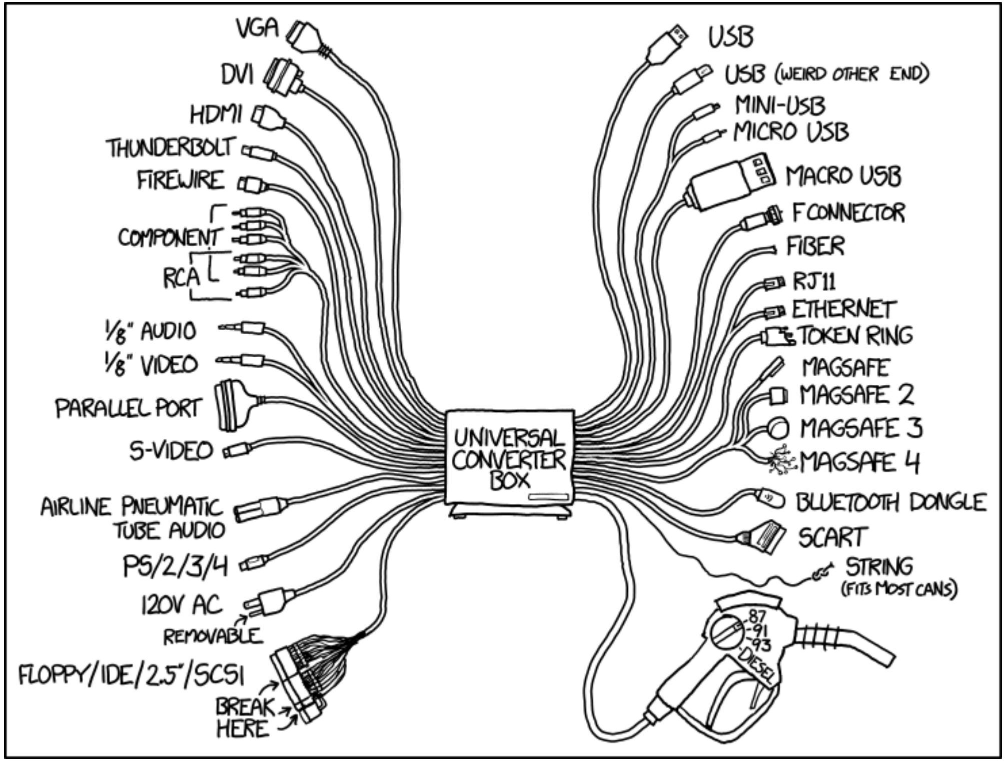
- **F**indable
- **A**ccesible
- **I**nteroperable
- **R**eusable



		Data	
		Same	Different
Code	Same	Reproducible	Replicable
	Different	Robust	Generalisable

(From Kirstie Whitaker)

MEG



- Each system has its own proprietary format
- Data organized differently between institutions and even within a lab
- No metadata
- Resources wasted rearranging data, reproducing datasets and reimplementing processing pipelines

WE NEED A **STANDARD**

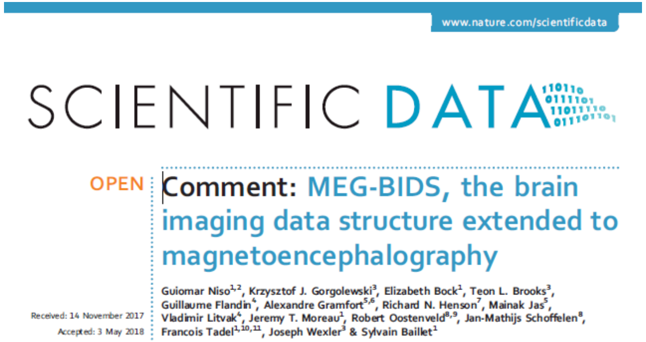
BIDS: Brain Imaging Data Structure

MEG extension of the BIDS

BRAIN IMAGING DATA STRUCTURE

A simple and intuitive way to organize and describe your neuroimaging and behavioral data.

http://bids.neuroimaging.io/



www.nature.com/scientificdata

SCIENTIFIC DATA

OPEN

Comment: MEG-BIDS, the brain imaging data structure extended to magnetoencephalography

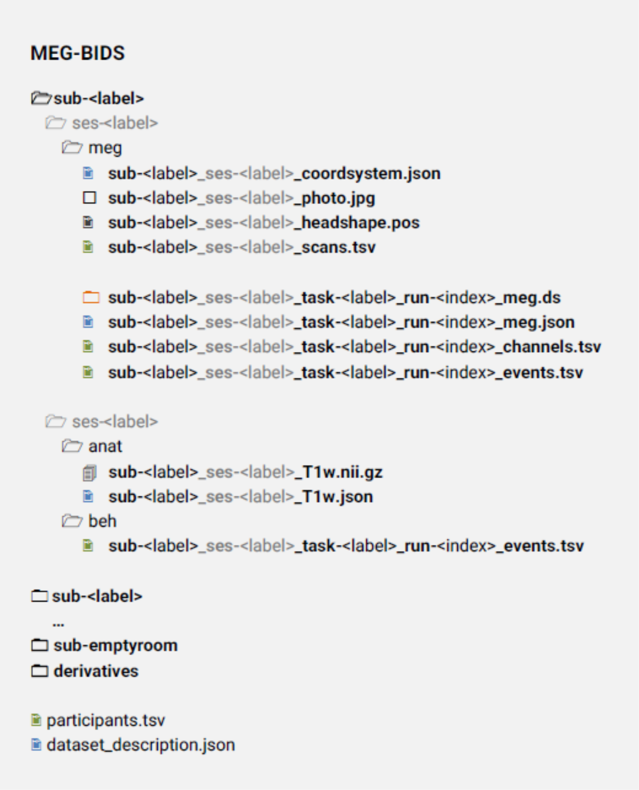
Guiomar Niso[1,2], Krzysztof J. Gorgolewski[3], Elizabeth Bock[1], Teon L. Brooks[3], Guillaume Flandin[4], Alexandre Gramfort[5,6], Richard N. Henson[7], Mainak Jas[5], Vladimir Litvak[4], Jeremy T. Moreau[1], Robert Oostenveld[8,9], Jan-Mathijs Schoffelen[8], Francois Tadel[1,10,11], Joseph Wexler[3] & Sylvain Baillet[1]

Received: 14 November 2017
Accepted: 3 May 2018

(Niso et al. *Scientific Data*, 2018)

MEG-BIDS

MEG-BIDS



MEG-BIDS

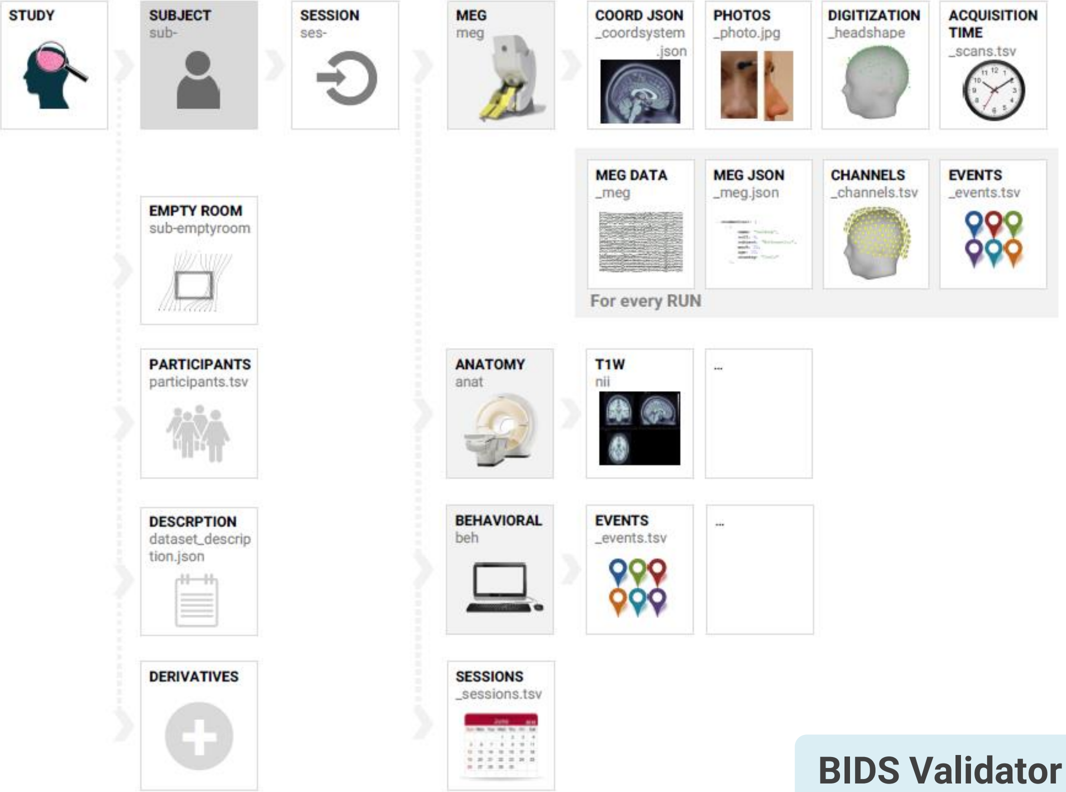
```
sub-<label>
  ses-<label>
    meg
      sub-<label>_ses-<label>_coordsystem.json
      sub-<label>_ses-<label>_photo.jpg
      sub-<label>_ses-<label>_headshape.pos
      sub-<label>_ses-<label>_scans.tsv

      sub-<label>_ses-<label>_task-<label>_run-<index>_meg.ds
      sub-<label>_ses-<label>_task-<label>_run-<index>_meg.json
      sub-<label>_ses-<label>_task-<label>_run-<index>_channels.tsv
      sub-<label>_ses-<label>_task-<label>_run-<index>_events.tsv

  ses-<label>
    anat
      sub-<label>_ses-<label>_T1w.nii.gz
      sub-<label>_ses-<label>_T1w.json
    beh
      sub-<label>_ses-<label>_task-<label>_run-<index>_events.tsv

sub-<label>
  ...
sub-emptyroom
derivatives

participants.tsv
dataset_description.json
```



BIDS Validator

(Niso et al. *Scientific Data*, 2018)

MEG-BIDS

Example: **sub-01_task-rest_meg.json**

```
{
"InstitutionName": “Montreal Neurological Institute",
"InstitutionAddress: “3801 University, Montreal, QC"
"Manufacturer": "CTF",
"ManufacturersModelName": "CTF-275",
"DeviceSerialNumber": "11035"
"SoftwareVersions": "Acq 5.4.2-linux-20070507",
"PowerLineFrequency": 60,
"SamplingFrequency": 2400,
"MEGChannelCount": 270,
"MEGREFChannelCount": 26,
"EEGChannelCount": 0,
"EOGChannelCount": 2,
"ECGChannelCount": 1,
"EMGChannelCount": 0,
"DewarPosition": "upright",
"SoftwareFilters": { "SpatialCompensation":
    {"GradientOrder": "3rd"}},
"RecordingDuration": 600,
"RecordingType": "continuous",
"EpochLength": 0,
"TaskName": "rest",
"ContinuousHeadLocalization": true,
"HeadCoilFrequency": [1470,1530,1590],
"DigitizedLandmarks": true,
"DigitizedHeadPoints": true
}
```

JSON files:

- Store metadata
- Readable by humans <u>and</u> machines

Open Software

Widely-used free and open MEG software packages have already added functionality to support **MEG-BIDS**

Brainstorm
(Tadel et al. 2011)

Fieldtrip
(Oostenveld, et al. 2011)

MNE python
(Gramfort et al. 2014)

SPM
(Litvak et al. 2011)

From raw MEG/EEG to publication: Frontiers special topic featuring open analyses of open data

Open Databases

HCP

HUMAN
Connectome
PROJECT

- 5-year project sponsored by the NIH
- 95 subjects on MEG / ConnectomeDB (out of the 1206 subjects)
- MEG/EEG: Resting-state and task-evoked, using same tasks and timing as in fMRI

CamCAN

camCAN
Cambridge
Centre for Ageing
and Neuroscience

- Cambridge Centre for Ageing and Neuroscience
- 650 healthy adults from 18-88 y.o.
- MEG: Resting-state and sensorimotor
- MRI: structural (T1, T2, Diffusion, MTR) and functional (rest, sensorimotor and movie)
- Demographic, lifestyle and cognitive data

OMEGA: The Open MEG Archive

neurospeed neuro McGill

OMEGA

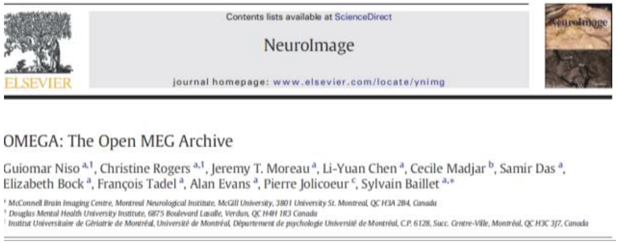
The Open MEG Archive

(Niso et al. *Neuroimage*, 2015)

Free repository of MEG data

- Over 220 participants at one or more time points
- Resting-state MEG
- T1-weighted anatomical MRI data
- Demographic data
- Total volume of ~400GB
- Over 1000 users since 2015

Now organized following the MEG-BIDS



Contents lists available at ScienceDirect

NeuroImage

journal homepage: www.elsevier.com/locate/ynimg

ELSEVIER

OMEGA: The Open MEG Archive

Guiomar Niso [a,1], Christine Rogers [a,1], Jeremy T. Moreau [a], Li-Yuan Chen [a], Cecile Madjar [b], Samir Das [a], Elizabeth Bock [a], François Tadel [a], Alan Evans [a], Pierre Jolicoeur [c], Sylvain Baillet [a,*]

[a] McConnell Brain Imaging Centre, Montreal Neurological Institute, McGill University, 3801 University St. Montreal, QC H3A 2B4, Canada
[b] Douglas Mental Health University Institute, 6875 Boulevard Lasalle, Verdun, QC H4H 1R3 Canada
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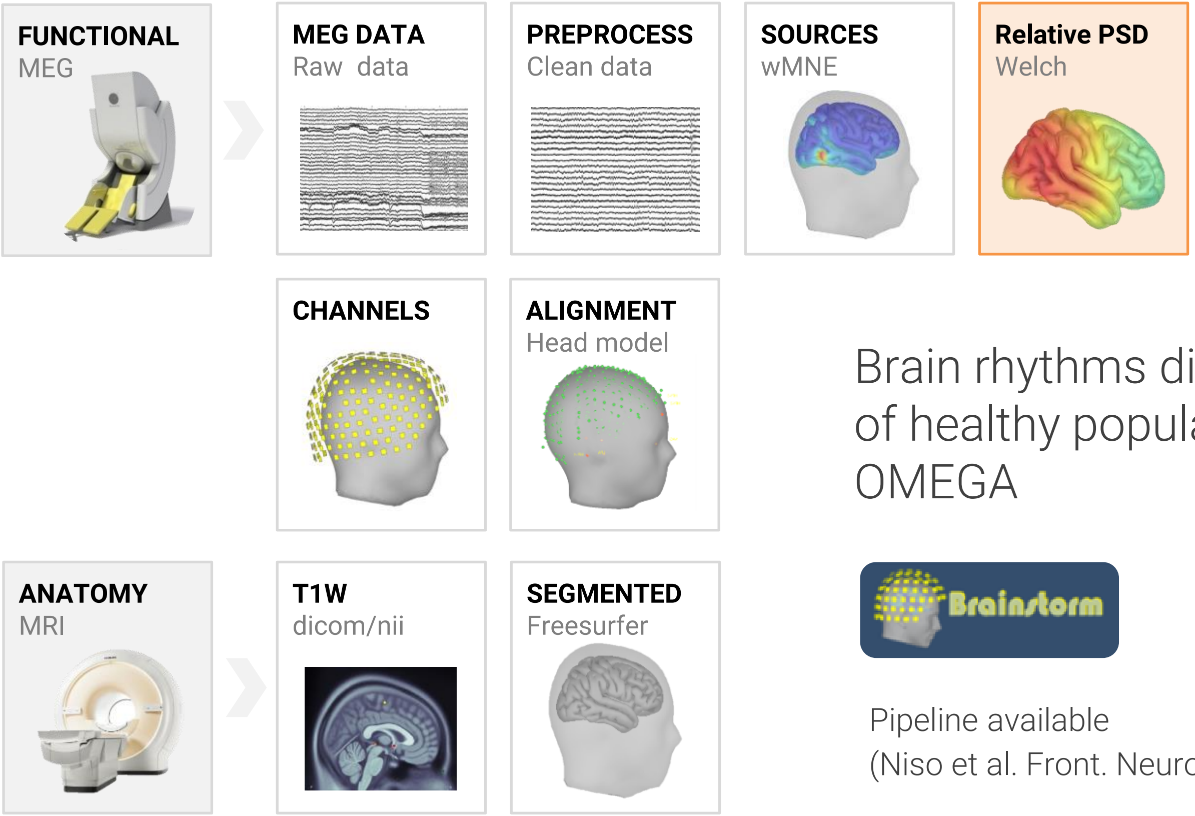
OMEGA user example



FUNCTIONAL
MEG

MEG DATA
Raw data

PREPROCESS
Clean data

SOURCES
wMNE

Relative PSD
Welch

CHANNELS

ALIGNMENT
Head model

ANATOMY
MRI

T1W
dicom/nii

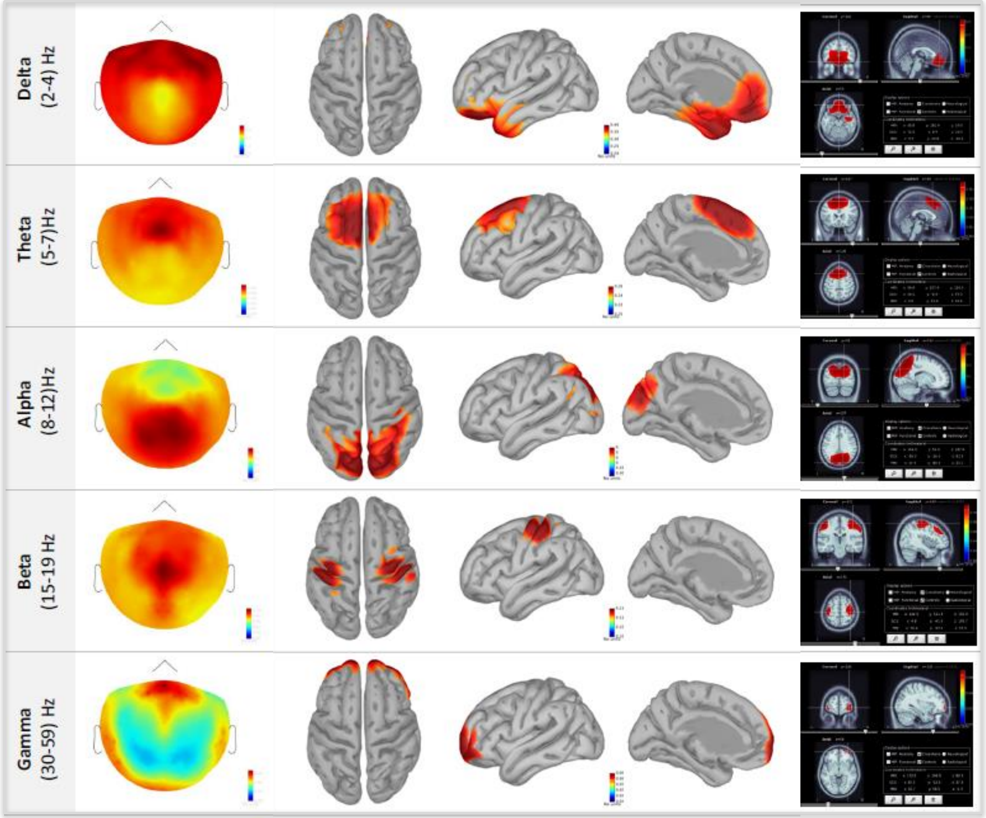
SEGMENTED
Freesurfer

Brain rhythms distribution of healthy population in OMEGA

Brainstorm

Pipeline available
(Niso et al. Front. Neurosci. *In press*)

Relative PSD



(Niso et al. *In preparation*)

Conclusions

Open Science
in MEG is
becoming a reality

MEG-BIDS
standard to
organize and share
your data

OMEGA:
The Open MEG
Archive

Brain rhythms
distribution of
healthy population
in OMEGA

¡MUCHAS GRACIAS!

POLITÉCNICA

AXA Research Fund

CTB centro de tecnología biomédica

neuro

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Guiomar Niso

August 2018

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